

Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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"We Have Liftoff!"

MESSENGER – set to become the first spacecraft to orbit the planet Mercury – launched on Tuesday, August 3, at 2:15 a.m. EDT aboard a Boeing Delta II rocket, lighting up the night sky around Cape Canaveral Air Force Station, FL.

The approximately 1.2-ton (1,100-kilogram) spacecraft, designed and built by the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, MD, was placed into a solar orbit 57 minutes after launch. Once in orbit, MESSENGER automatically deployed its two solar panels and began sending data on its status. Once the mission operations team at APL acquired the spacecraft's radio signals through tracking stations in Hawaii and California, Project Manager David G. Grant confirmed the craft was operating normally and ready for early system check-outs.



"All the work that went into designing and building this spacecraft is paying off beautifully," Grant said. "Now the team is ready to guide MESSENGER through the inner solar system and put us on target to begin orbiting Mercury in 2011."

"It took technology more than 30 years, from Mariner 10 to MESSENGER, to bring us to the brink of discovering what

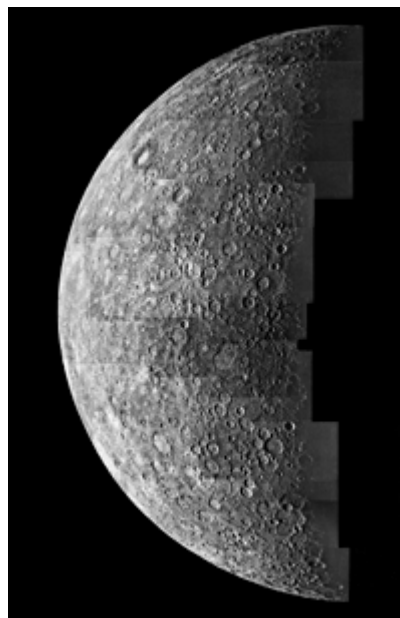
Mercury is all about," said Dr. Sean C. Solomon, MESSENGER's principal investigator from the Carnegie Institution of Washington, who leads a science team of investigators from 13 institutions across the U.S. "By the time this mission is done we will see Mercury as a much different planet than we think of it today."

To watch a replay of the launch, click [here](#). Visit the [MESSENGER](#) web site for photos of the launch and more information about the mission.

MESSENGER: Unlocking the Mysteries of Mercury

The [MESSENGER](#) mission is often described simply as "a scientific investigation of the planet Mercury." That's an accurate statement, but it doesn't begin to tell you why the mission is so significant or why we know so little about the tiny planet closest to the Sun.

Mercury is difficult for astronomers on Earth to view through telescopes because they must look toward the Sun. If too much sunlight gets in, the retina could easily be damaged. The Hubble Space Telescope has never



Mercury as seen by Mariner 10 in 1974 from a distance of 125,000 miles. MESSENGER will orbit as close as 125 miles from the surface.

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Discovery Home Page

<http://discovery.nasa.gov>

photographed Mercury for much the same reason – stray light from the Sun could damage its electronics. There are only about 30-40 days per year when Mercury isn't too close to the Sun to be viewed from Earth, and factoring in bad weather means even fewer possible days.

Sending a spacecraft to Mercury has been done only once before – Mariner 10 in 1974. The big challenge for a spacecraft is the huge gravitational pull of the Sun. For Mariner 10 engineers devised the concept of “gravity assist,” flying by a planet to take advantage of its gravitational pull as a braking technique to slow the craft and send it where they want. Mariner 10's flyby of Venus on the way to Mercury produced the first clear pictures of its clouds and returned other atmospheric data. The gravity assist enabled the spacecraft to encounter Mercury at six-month intervals for three mapping passes over the planet, coming about as close to Mercury as we are to the Moon. Because of Mercury's slow rotation, half of the planet was always in the dark when Mariner 10 sped by so only half of the globe was able to be photographed. And while this gave scientists more information on the planet than they'd ever had before, more than solving any mysteries Mariner 10 mainly begged more questions.



On July 27 at Launch Pad 17-B at Cape Canaveral Air Force Station, the first half of the fairing, at right, is moved into place for installation around the MESSENGER spacecraft. The fairing is a molded structure that fits flush with the outside surface of the upper stage booster and forms an aerodynamically smooth joint, protecting the spacecraft during launch.

With its suite of seven miniaturized instruments, MESSENGER, short for MERcury Surface, Space ENvironment, Geochemistry, and Ranging, will address many questions that are key to understanding terrestrial planet evolution. Among the ambitious science objectives

are: to learn more about Mercury's bulk composition and what that tells us about planet formation in general; to investigate its volcanic, tectonic, and internal evolution; and to understand how the planet's magnetic field originated and determine whether there is a liquid outer core. Mariner 10 discovered that Mercury has a weak magnetic field, thought to arise from an electromagnetic dynamo created in a liquid metallic outer core. Because the planet is small, scientists thought that the core had cooled and solidified long ago. MESSENGER will investigate this question as well as the nature of the planet's thin atmosphere and the composition of the permanently shadowed polar deposits. The knowledge could have major implications for some of astronomy's most important questions, including how our solar system formed and how other life-supporting solar systems formed.

Designing a spacecraft and instrument to survive the harsh environment of Mercury and to fly as close as 125 miles from the surface took a great deal of creativity. MESSENGER's dual-mode, liquid chemical propulsion system is integrated into the spacecraft's structure to make economical use of mass. The structure is primarily composed of a graphite epoxy material which provides both the strength necessary to survive launch and lower mass. Two large solar panels, supplemented with a nickel-hydrogen battery, provide MESSENGER's power.

A key MESSENGER design element deals with the intense heat at Mercury. The Sun is up to 11 times brighter than we see on Earth and surface temperatures can reach about 840 degrees Fahrenheit, but MESSENGER will operate at room temperature behind a sunshade made of heat-resistant ceramic cloth.

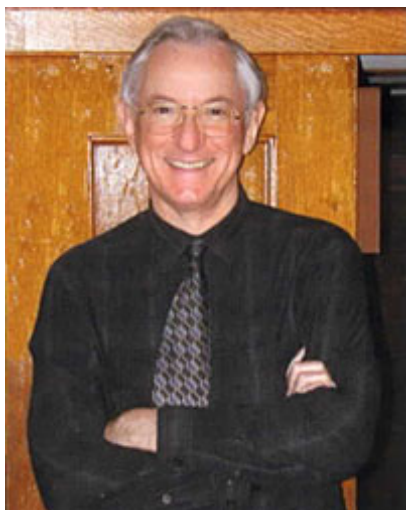
After launch on August 3, 2004, MESSENGER will return to Earth for a gravity boost in August 2005, then fly past Venus twice, in October 2006 and June 2007. The spacecraft uses the tug of Venus' gravity to resize and rotate its trajectory closer to Mercury's orbit.

Three Mercury flybys, in January 2008, October 2008 and September 2009, will put MESSENGER in position to enter Mercury orbit in March 2011. During the flybys the spacecraft will map nearly the entire planet in color, image most of the areas unseen by Mariner 10, and measure the composition of the surface, atmosphere and magnetosphere. It will be the first new data from Mercury in more than 30 years and will provide valuable information for selecting targets for MESSENGER's year in orbit.

It took a large dedicated team of people from many institutions around the country to get this important mission to the launch pad. Principal Investigator Sean Solomon says, “We were ambitious from the outset, and some of our initial optimism had to be met with very clever solutions to the technical challenges that we faced. It's turned out to be every bit as hard as we thought it would be and then some. We've encountered delays and inevitable growth in cost as a result, but we think we have a very good spacecraft about to launch.” Let the journey begin!

MESSINGER Principal Investigator Sean Solomon

In 1974, Sean Solomon was a young assistant professor of geophysics at the Massachusetts Institute of Technology (MIT) who had been studying the Moon. Then Mariner 10 flew past Mercury and changed everything. Sean became fascinated with Mercury. He recalls, "I was particularly intrigued by the discovery of the magnetic field and of the lobate scarp and the notion that the planet may have contracted globally as a result of cooling or solidification of the core. I was interested in how the inner planets evolved and how they got rid of their internal energy, what that meant for volcanic histories and other kinds of deformation. Mercury was just a wonderful example of behavior that wasn't seen on any of the other planets. Yet the Mariner 10 data were clearly limited, both in the kinds of things they measured and in their coverage. It was obvious in 1974 that the next thing that needed to be done at Mercury was an orbiter. It's just that at that time nobody knew how to do it."



Sean Solomon

Fast forward to 2004 and Sean Solomon is leading the team that has figured out how to do it. The **ME**rcury **S**urface, **S**pace **EN**vironment, **GE**ochemistry, **R**anging mission is preparing to launch and begin its long and winding journey to the closest planet to the Sun. The spacecraft has faced a number of challenges since being selected as the seventh Discovery mission in 1999, but as this is written, launch is quickly approaching with all systems go.

Sean was born in Los Angeles, California. When he was about 5 he became fascinated with paleontology because of dinosaurs, and he read children's books about them. "I was able to wow the adults that I met by being able to say 'paleontologist' as well as know what it meant," he remembers. He said that science always interested him and that he was good at math and found it fun. He said, "My direction sort of wandered all over the map until college when I got exposed to earth science and planetary science and some influential mentors."

Sean went to Caltech in the 1960's intending to pursue physics, as did most of the entering class. He said it was the equivalent of computer science today in that most science oriented students thought they would go into physics. However the physics department went out their way to discourage majors by making the opening courses difficult and telling students they really should think about alternatives. Sean discovered Caltech's geology and planetary sciences division had some really good professors teaching the introductory classes. He found it to be a fascinating place, as they were working on scientific questions that were not typically taught in high school. Most of the incoming students didn't know very much about the things that interested the geologists, geophysicists and planetary scientists. "That was an eye opener for me," Sean recalls, "By the end of my sophomore year I was majoring in geophysics." He credits Bob Sharp, an eminent geologist who spent 56 years at Caltech, with bringing him into the field.

After receiving his B.S. from Caltech, Sean went to MIT for his graduate work, where he completed his Ph.D. in geophysics in 1971. He was offered a position on the faculty shortly after graduation. He says MIT was in a state of rapid change at the time, Frank Press had recently moved there from Caltech and was given the license to make the Earth and Planetary Sciences department one of the best in the country. "He was busy hiring new faculty and constructing new labs," Sean recalls, "It was a place where it was easy to do both Earth science and planetary science. That was important for me because I had interests that spanned both our own planet and planets similar to the Earth. There are times that are very rich in new data and there are times that are very lean. The ability to go back and forth between interesting questions in Earth science and planetary science really enables one to be an opportunist and to take advantage of where the interesting new questions can be addressed because of new data. In the lean times you can turn your attention to problems that are ripe for solving on Earth."

Sean didn't think he would ever leave, but after 20 productive years at MIT that included numerous visiting appointments, honorary lectureships, awards, oceanic expeditions, editorial experience and professional committees, he was recruited by the president of the Carnegie Institution of Washington (CIW) to head the Department of Terrestrial Magnetism. "It's a place where one does only research," he said, "where there's generous support that comes from a healthy endowment as a private non-profit institution, where there are neither very large demands to do anything other than do good science nor the kinds of pressures that one finds at primarily research institutions. It is a throwback to an ivory tower concept where there are some real opportunities to make a difference. In my position not only was I supported in my own work and but I had an opportunity to help recruit some of the new scientific staff."

Sean says, "The one thing I miss about not being at a university is that we don't have a lot of graduate students or the energy of a student population, but we find that enthusiasm and renewal of ideas with a very strong post-doctoral program. The post docs are a very important part of our research. We make sure the post docs have

whatever they need to advance their own research careers and to get something interesting accomplished."

Meanwhile, Sean's desire to unlock Mercury's mysteries persisted. He says, "For me to get seriously interested in investing time in an actual mission design and proposal, it took the Discovery Program to come along." It also took some very innovative folks at the Applied Physics Lab in Laurel, MD, to convince him there was a technical solution to the many challenges that face Mercury orbiter missions. "Thermal, mass, mission design are the three biggest challenges," he says. "We proposed twice to the Discovery Program. The first time, in 1997, we weren't selected because of concerns NASA had over our thermal design, particularly our solar arrays. We did a lot of work on testing the design using internal funds at APL and testing facilities at NASA's Glenn Research Center, enough that by the time we proposed the second time we had a lot of measurements and simulations we could use to back up the claim that we knew how to fly solar arrays at Mercury's distance from the Sun."

When the original March 2004 launch date changed, so did the mission design. Sean says, "Instead of 5 years in cruise we now have over 6-1/2 years so it's a much longer mission. We have to worry about the lifetime of every component of the spacecraft and the health of all our co-investigators a bit longer. We now have orbit insertion in 2011 instead of the middle of 2009." The instruments will be turned on right after launch, and the Earth flyby in 2005 will be an important source of calibration information. The Venus flybys will provide a full shakedown opportunity for the operations team. "We want to get the most data out of each of the Mercury flybys," Sean says, "so we want not only to have functioning, calibrated instruments but we want to have the procedures for getting the maximum scientific return out of flybys ready for the first Mercury encounter that comes early in 2008. We'll be seeing terrain at very high resolution that has never been seen close up, that was not viewed by Mariner 10. The wonderful thing about having the flyby data to ponder for 3 years is that when we get into the orbital phase we will have time for targeted observations. We'll be in orbit for 2 solar days at Mercury, or one Earth year. Once we map the entire planet in the first solar day, our intent is to use the second half of the orbital phase for imaging to do targeted high resolution work. The flyby images will help us make the decisions for selecting targets."

Does he have advice for future PIs? Sean says, "I think one should not enter into a PI role for a mission hastily, it is a very large investment. In my case it is one I was quite willing to make at a comparatively late stage in my career. I think it would have been difficult to continue to be scientifically productive and take on this kind of role at a much earlier stage. One of the things I would caution is that young scientists not be pressured into taking on this kind of role too early in their careers. The second piece of advice is that one should pick very carefully the mission opportunities in which one steps up to take a large role. It is a very, very large effort, a big commitment of time, energy and worry, and to be a satisfying experience the whole enterprise has to be something that one deems scientifically of the highest priority, really worth the investment of labor."

For Sean, sending a spacecraft to orbit Mercury and complete the exploration that Mariner 10 began 30 years ago is definitely in that category. "It has been a long road and it's been hard and there have been some frustrations, but the goals of this mission are still really first order scientific issues for planetary science. Knowing that," he says, "has kept a lot of us working as hard as we have." When MESSENGER's ground-breaking results emerge, no doubt more questions will be raised, leaving it to the next generation of inspired young scientists to pursue those answers.

MESSENGER Project Manager David Grant

Dave Grant calls himself a "lifer." He has spent his entire career at the Johns Hopkins University Applied Physics Lab (APL), working on many interesting missions and projects, culminating with the successful launch of MESSENGER.



Dave Grant

Dave grew up in Fall River, Massachusetts. He had three brothers, which must have been a handful for his mother, but he says she's 92 now and still the boss. He loved baseball as a kid, and that passion has remained. "I was quite a Red Sox fan back then," he says, "I stayed with them for 50 years, then gave up and went with the Orioles."

Dave's interest in engineering began in high school. He says he was always a strong student in both math and physics, and he was analytical. He was the guy people brought their radios to when they didn't work. He says engineering was a way to apply what he had learned, to create something and see its final outcome.

Dave graduated from Southeastern Massachusetts University with a degree in electrical engineering. He then received a master's degree in mathematics from the University of Maryland. To become an electrical engineer, he also studied physics and mechanical engineering.

After college, Dave began working at APL. That was 45 years ago, the same year he got married. "The best part," he says, "is working with the hardware. When I first came here, everything was done in a laboratory setting. Now, everything is done on the computer. I enjoy my job very much, and although it has changed significantly over the years, I still look forward to coming here every day and working with interesting and exciting new projects."

Dave's early years at APL were spent as an engineer in fleet defense, working on programs that preceded the Aegis system, then he moved on to the nuclear sub-defense program. Since APL is part of Johns Hopkins University, he was given an opportunity in the 1970's to work in the oncology center at the School of Medicine where he helped

develop radiation therapy machines. After 8 years he came back to APL's Space Department where he has remained ever since.

In the early 1980's he supported a mission called Polar Bear designed to study communications interference caused by solar flares and increased auroral activity. He managed the TIMED mission which launched in December 2001 to study the influences of the Sun and humans on the least explored and understood region of Earth's atmosphere – the Mesosphere and Lower Thermosphere/Ionosphere. "TIMED has been a very successful mission," Dave says, "It's one of the prouder accomplishments of my career."

Dave was tagged to take over as MESSENGER project manager when Max Peterson retired in January 2003. The mission has faced many challenges since that time. Dave acknowledges it's been tough in all aspects of the work: technical, schedule and budget. The most challenging part, in Dave's view, was getting the technology under control. He says the MESSENGER mission has two things that make it difficult. One is the temperature at Mercury. The second is the fact that there is very little weight margin in the design. "As a consequence," he says, "we had to build a highly integrated spacecraft where we put a lot of functionality into very small packages. Those two factors caused us to introduce of necessity a lot of new technology. New technology comes with the "D" word, development, which is the bane of the program manager. We had to do quite a bit of development and that meant a lot of testing and then schedule impact. The big challenge throughout was to keep our cost down and get the work done on time. But fortunately at the end of the day, we did get all the work done, we did develop all the things we needed, they were tested properly and thoroughly, and we're fully integrated so it all worked out."

After launch, Dave plans to take some well-deserved vacation, but then he'll be back to continue in his role. "This next phase of the program is not a walk in the park either. We have six major events, we have five deep space maneuvers, so it's not a trivial situation. We have to be very careful with our fuel. It's going to continue to be challenging."

The role of a project manager is wide-ranging, overseeing development, contracting, negotiating, financing, scheduling and operation. It also includes keeping the team motivated. "That's a challenge," Dave says, "because in this environment people work very, very hard. They work a lot of nights and weekends, they give up vacations; families sacrifice because of that. You have to work with the people to be sure that there are no true hardships inflicted on their families. We've got an outstanding group of people on this program, very high caliber engineers. To make the schedule, extra hours and six-day weeks are necessary, there's no other way to get the work done. The people have responded to the program and do it without complaining. I'm very grateful for that, believe me. We have people who are motivated to get the job done."

Dave and everyone on this hard working team were rewarded with a magnificent launch and the satisfaction of knowing that their efforts will make it possible for humans to see Mercury as never seen before and to learn more about the formation of the solar system than we know today.

collected material has the potential to tell us more about the origin of the solar system than we've ever known.

After launch in August 2001, Genesis spent 884 days in a halo orbit 9 million miles from the Earth collecting solar wind particles. In April of 2004 the sample collection was completed, and the spacecraft headed home. It's now on final approach carrying NASA's first samples from space since Apollo 17 returned the last moon rocks in December of 1972. Follow the progress of the spacecraft [here](#).

Helicopter flight crews, navigators and mission engineers are preparing for the return of the spacecraft. The sample return capsule will re-enter Earth's atmosphere for a planned mid-air recovery at the U.S. Air Force Utah Test and Training Range (UTTR). To preserve the delicate particles of the Sun, specially trained helicopter pilots will snag the return capsule from mid-air using custom-designed hooks. The flight crews for the two helicopters are comprised of former military aviators and Hollywood stunt pilots.



Recent mid-air capture test shows the helicopter snagging the parachuting sample return capsule over the UTTR.

Education and Public Outreach Highlights

The Genesis Education and Public Outreach team has conducted presentations and summer academies for educators that center upon the upcoming mid-air capture and sample return event.

Academies have been held at the Denver Museum of Nature and Science, the Challenger Center at the Houston Museum of Natural Science, Slippery Rock University, Slippery Rock, PA, the University of Utah in Salt Lake City and Wichita State University, KS.

A public event is planned for Sept. 8 at Kingsbury Hall on the University of Utah campus where NASA will supply a live mission feed via satellite feed from the UTTR so the public can view the event as it happens on the 20' x 30' screen.

Genesis is Homeward Bound

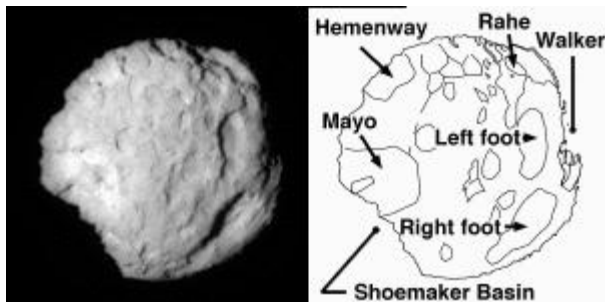
The [Genesis](#) spacecraft is on the final leg of its long journey to collect and bring back to Earth samples of solar wind. On September 8, a dramatic mid-air capture will gently return the precious samples to Earth. The tiny amount of 0.4 milligrams of

Stardust Encounter Bring Surprises

Stardust Principal Investigator Dr. Donald Brownlee of the University of Washington, Seattle, described the unexpected results of Stardust's historic encounter with Comet Wild 2 in one of four Stardust articles that were featured in the June 18, 2004 issue of *Science*.

The images revealed a much stranger world than previously believed. The comet's rigid surface, dotted with towering pinnacles, plunging craters, steep cliffs, and dozens of jets spewing violently, has surprised scientists.

"We thought Comet Wild 2 would be like a dirty, black, fluffy snowball," said Brownlee. "Instead, it was mind-boggling to see the diverse landscape in the first pictures from Stardust, including spires, pits and craters, which must be supported by a cohesive surface."



The picture on the left is the closest short exposure taken of the comet by Stardust. The diagram on the right shows names used by the Stardust team to identify features. "Basin" does not imply an impact origin.

Stardust gathered the images on Jan. 2, 2004, when it flew about 147 miles from Wild 2. The flyby yielded the most detailed, high-resolution comet images ever.

"We know Wild 2 has features sculpted by many processes. It may turn out to be typical of other comets, but it is unlike any other type of solar system body," Brownlee said. "We're fortunate that nature gave us such a rich object to study." Stardust images show pinnacles 328 feet tall and craters more than 492 feet deep. Some craters have a round central pit surrounded by ragged, ejected material, while others have a flat floor and straight sides.

"Another big surprise was the abundance and behavior of jets of particles shooting up from the comet's surface. We expected a couple of jets, but saw more than two dozen in the brief flyby," said Dr. Benton Clark, chief scientist of space exploration systems, Lockheed Martin Space Systems, Denver.

The team predicted the jets would shoot up for a short distance, and then be dispersed into a halo around Wild 2. Instead, some super-speedy jets remained intact, like blasts of water from a powerful garden hose. This phenomenon created quite a wild ride for Stardust during the encounter.

The violent jets may form when the Sun shines on icy areas near or just below the comet's surface. The solid ice becomes a gas without going through a liquid phase. Escaping into the vacuum of space, the jets blast out at hundreds of kilometers per hour.

The Stardust team theorizes sublimation and object hits may have created the comet's distinct features. Some features may have formed billions of years ago, when life began on Earth, Brownlee said. Particles collected by Stardust may help unscramble the secrets of how the solar system formed.

In July, Stardust was highlighted at the 35th COSPAR Scientific Assembly with seven talks on the Wild 2 scientific results plus four talks on technology advances for particle extraction from aerogel. Many other talks on small bodies and Mars included STARDUST results for comparative planetology.

Bob Metzger Loses Battle with Cancer

Bob Metzger, who managed the Discovery Program Support Office at JPL, died on May 25 from cancer of the esophagus. Bob joined JPL in 1990. Prior to establishing the Discovery support office in April 1999, he worked with the New Millennium Program. He left Discovery in January of 2002 when he was asked to head up JPL's new Costing Office, to assure more accurate cost estimates for new proposals.

Bob had a distinguished career as a lieutenant colonel in the U.S. Army. He is survived by his loving wife Linda, son Marc, daughter Cheryl Vierregger, and grandchildren whom he adored. He was buried at Arlington National Cemetery.



The Discovery Program Support Office staff in 2001. Back row, Andy Hernandez and Bob Metzger; front row, Barbara Cantu and Shari Asplund.

Deep Impact on Track for December Launch

The [Deep Impact](#) project is making progress on all the issues and concerns they have been dealing with over the past several months. The Flight System has completed its environmental test suite and the Impactor stand alone environmental tests will be completed in early August. The Mission Readiness Test Program is making progress toward meeting pre-ship requirements. A wide array of tests and reviews will take place as the march toward launch continues.

Education and Public Outreach Highlights

The Deep Impact (DI) E/PO team is hard at work planning for the launch in December and the encounter in July 2005. The team has formed and nurtured relationships with organizations like the Girl Scouts of the USA. In April, DI was the featured science hour for over 180 girls who learned to sing about comets, listened to a comet myth filled with science facts, and built their own comet models. DI outreach members were the keynote speakers at a Girl Scout Day at the University of California Riverside, sponsored by the Society of Women Engineers and the Riverside Astronomical Society.

DI was featured at both Maryland Day at the University of Maryland and the Jet Propulsion Laboratory's Open House. Solar System Ambassadors from several locations spent two days at JPL's Deep Impact exhibit to share their excitement with attendees. DI gave a presentation to faculty from more than 30 institutions at a Tribal College conference at JPL. The team continues to carry the DI story to classrooms, businesses and star parties across the country.

Amateur astronomers are gearing up to observe Comet Tempel 1 again as it becomes observable from Earth, and the University of Maryland continues to gather new members for their [Small Telescope Science Program](#) to which amateur astronomers submit their observations. During encounter, these very important members will be watching from Earth through their telescopes.



Solar System Educator Dee McClellan's class is going to determine how many pennies are needed to match the weight of the copper in the impactor.

The Deep Impact e-newsletter celebrated its one year anniversary with over 16,000 subscribers. One enthusiastic Solar System Educator, Dee McClellan, put her class to work calculating and measuring to gather the amount of pennies needed to match the mass of the copper in the DI impactor. The class cashed in donations from the

community and drained their local bank of pennies, gathering over \$500. The funds went to their sister school in the Ukraine to support their science and math program.

Deep Impact outreach members attended the dedication and blessing ceremony for the Mauna Kea Astronomy Education Center's construction site in Hilo, Hawaii. Set to open next year, the Center looks forward to featuring Deep Impact as its highlight event to end a week long training for island teachers. Planning meetings were held to draw together all Hawaii-based Deep Impact outreach members from the Solar System Ambassador Program, the Solar System Educator Program, the University of Hawaii, Onizuka Museum in Kona and the Mauna Kea Astronomy Education Center to leverage new and existing events on the island for the next year. Deep Impact will be joining the Center's efforts to combine science and culture on the Hawaiian islands.

Kepler Gearing up for PDR

The [Kepler](#) Mission is making good progress as it heads for Preliminary Design Review (PDR) in October, with instrument and element PDRs scheduled in August. Flight software development and test plans are being formulated. The ground segment PDR is planned for September.

The science team met in early June. The Participating Scientist and Guest Observer Plan has been approved by the Program Scientist. Observations for the Stellar Classification Program are underway.



This photo shows the Kepler satellite simulation exhibit, as seen at the AAS meeting in Denver.

Education and Public Outreach Highlights

A LEGO version of the Kepler Transit exhibit was on display at the AAS meeting May 31-June 4, 2004, in Denver. It has a 3-planet orrery (a moving model of a star-planet-system) that is either hand-crank or motorized, a light sensor, and computer display of light curves generated in real time. The model is an excellent simulation that quickly conveys the concept of the Kepler mission to detect extrasolar planets—especially habitable planets—by the transit method. Many people wanted the plans/instructions for constructing the LEGO component. Instructions for LEGO version of the Kepler Transit exhibit are complete and posted on the Kepler website for general use and reference:

<http://www.lawrencehallofscience.org/kepler/>.

Dawn Development Continues

The goal of the [Dawn](#) mission to asteroids Ceres and Vesta is to characterize the conditions and processes of the solar system's earliest epoch by investigating two of the largest protoplanets remaining intact since their formations. It will provide data on the role of size and water in planetary evolution and form a bridge between the exploration of the rocky inner solar system and the icy outer solar system. With a planned launch scheduled for June 2006, building and integrating the spacecraft and payload are well underway.



Dr. Arlene Russell, CPR Project Director-UCLA, explains how to implement CPR.

Education and Public Outreach Highlights

Teachers tapped into cutting-edge educational technology during a three-day [Calibrated Peer Review™](#) workshop sponsored by the Dawn mission. Designed to help teachers integrate writing in the content areas, Calibrated Peer Review™ (CPR) is a suite of integrated, Internet-based tools that enables students to learn by writing and receiving peer feedback. Dr. Arlene Russell (UCLA), Joe Wise (New Roads School), and John Ristvey (McREL) facilitated the July workshop at Mid-continent Research for Education and Learning.

During this three-day intensive workshop, teacher participants experienced CPR assignments from a student's perspective and learned how to implement the program in their classes. Teachers also previewed activities from the forthcoming science education module *The History and Science of NASA's Dawn Mission* while creating assignments to connect CPR, Dawn mission content, and their specific curriculum. The collaboration between teachers and the DAWN E/PO team yielded benefits for the classroom. Teachers informed the development of Dawn's educational materials by sharing their classroom expertise, and Dawn E/PO expanded teachers' repertoire of effective teaching tools by providing experiences with the Calibrated Peer Review program. One workshop participant described the CPR program as "every teacher's most valuable tool for improving students' critical thinking and writing."

Scenes from JPL Open House May 2004



Chet Sasaki demonstrates Kepler's transit method to detect planets.



Marc Rayman at the Dawn display.



Don Sweetnam with a Genesis collector array.



Maura Rountree-Brown and Paula Pingree at the Deep Impact exhibit.

Discovery Dispatch

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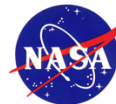
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